National Aeronautics and Space Administration

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Aerobic Rotational Membrane System (ARMS)

A research project under way at NASA's Kennedy Space Center, Fla., is putting its ARMS around a wastewater challenge on the International Space Station. The Aerobic Rotational Membrane System (ARMS) may lead to cleaner water and more cargo space. In ways such as this, exploration of space accelerates innovation on Earth.

Due to limited storage space available onboard the Space Station and on future space exploration missions, crew members must conserve as much water as possible. One method of maximizing water usage is to collect, clean and reuse wastewater from the sink and shower, and from urine and condensation.

"We're trying to move toward a biological treatment method using bacteria to help cleanse the water," said Tony Rector, a Dynamac Corporation bioprocess engineer at KSC.

In the SLS Lab, Rector conducts a daily monitoring of the ARMS during a testing cycle.

Dynamac Bioprocess Engineer Tony Rector prepares one of the reactor vessels on the Aerobic Rotational Membrane System bioreactor for initial testing in the Space Life Sciences Lab.

"An efficient biological treatment method would reduce the amount of contaminants the physical and chemical processes would have to remove, further treating the water to potable standards."

Reducing the contaminants on these downstream processes would, in turn, reduce the consumable costs associated with them.

A model of the system, designed by Rector and his colleagues and fabricated by the KSC Prototype Shop, is being tested inside the Space Life Sciences Lab. KSC researchers are treating water to remove as much of the contaminants contained in a waste stream as possible.

The ARMS reactor vessel, comprising 115 tubes called "membranes," delivers gaseous oxygen to bacteria. Fed by the oxygen, thin films of beneficial bacteria called "biofilms" grow across the surface of the

membranes and cleanse the water.

A computer controls oxygen delivery, pumping, pH levels, fluid and gas delivery systems of the ARMS. Test results are provided in real time so researchers have the most accurate and up-to-the-minute information possible.

In comparison to other biological treatment reactors, the ARMS is unique because the membranes rotate, exposing the bacteria to more contaminants. The rotation aspect of the system increases the chances of developing uniform biofilms and may alleviate limitations that could be experienced with operation in a micro- or low-gravity environment.

Biological treatment reactors have not flown in space, but the technology has been extensively ground-tested. Researchers are working to improve the reactors so they may one day be used for new, gravity-dependent initiatives, such as bases on the Moon or Mars.

The ARMS bioreactor inside the SLS Lab.

For more information about space research on the Internet, visit:
http://spaceresearch.nasa.gov

To obtain photos of the ARMS on the Internet, visit:
http://mediaarchive.ksc.nasa.gov/index.cfm (category SLS Lab-SERPL)

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